TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. IV No. 3. MARCH, 1927. PRICE 6d.

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 1983.

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

THE ROYAL CHARTER.

II.

In our last issue a brief description was given of the instructional and educational side of the Imperial College of Tropical Agriculture. It should be realised, however, that it has always been intended by the Governors of the College that instruction should form only one feature of the College's activities, although possibly at the present time it may be the most urgent one owing to the pressing need that has comparatively suddenly arisen for the provision of trained scientists to develop the tropical dependencies of the Empire. The other main branch of the College's activities is that of Research and in the brief account given below an endeavour will be made to show what promising progress has been made in elucidating some of the problems that have presented themselves although the members of the staff have had in some instances to contend with certain of those obstacles such as shortage of personnel and funds that are almost invariably met with in a newly established and rapidly expanding Institution of this sort, and more especially in one situated in the Tropics.

It has been the policy of the College to confine its efforts, so far as possible, to major problems of research, that is to say to problems that have a broad application, are of importance to a wide range of countries and that are likely to require such prolonged and intricate investigation that they are probably beyond the means and capacity of the local Agricultural Departments.

In some instances, however, the College is working in collaboration with the local Department as in the case of the investigation against the Froghopper Blight in Trinidad. In this case the Principal and some of the College staff are on the General Committee and one of the professors is Chairman of the Scientific Committee which is dealing with the actual experimental measures. The Froghopper Blight presents a very complicated problem. The life history of the pest has been worked out in considerable detail and it has been recognised for some time past that the solution is not purely an entomological one, but that soil conditions and the physiological condition of the plant are probably equally important factors. Certain measures have been devised for checking the pest and minimising the damage it does. These consist in arrangements for noting the first appearance of the nymphs soon after the commencement of the rainy season and of attacking the first-brood without delay by means of certain

insecticides, one of which, viz.: cyanogas, appears to offer prospects of success. The problem of the permanent eradication and control of this pest is however a much wider one and necessitates a study of certain fundamental problems. These studies are bound to take time, necessitating as they do much detailed work on the cane soils of Trinidad in the field as well as in the laboratory and they are being carried out by the College.

Another major problem is that of the Panama Disease which is doing a great deal to endanger the whole banana export trade from this part of the world. The Gros Michel banana has up to the present been the standard export variety but unfortunately it is particularly susceptible to this disease. The problem that the College has set itself the task of solving is the production of a new banana, which while retaining all the desirable qualities of the Gros Michel variety from the point of view of carrying capacity and suitability for the overseas market, shall be so sufficiently resistant to Panama disease as to make banana cultivation a more profitable and less risky business to the grower than it is at present. Considerable progress has been made in this direction and the problem is being approached from somewhat different angles. In the first place a collection has been made of different kinds of bananas and it has been definitely established that some of them such as the Giant Fig, the Cavendish and the Congo show great powers of resistance to this disease. At present, however, all of them show one or more slight defects so far as their carrying capacity is concerned. These details will have to be threshed out and it is believed that a necessary adjunct to the work will be the establishment of an experimental cold storage plant since it seems probable that each of these varieties many have its optimum mean temperature for long distance carriage. The composition of the atmosphere in the cold store during transit will also probably need study. The erection of such an experimental cold store is now being contemplated and its use could easily be extended so as to embrace an investigation into the requirements of other tropical fruits such as mangoes and avocado pears, in addition.

The Plant Genetics Department of the College is also attempting to solve the riddle by breeding disease resistant types and although no new banana of a kind absolutely suited in all respects to the export trade has yet been raised, sufficient progress has been made to indicate that the object may ultimately be achieved and that the work is proceeding on promising lines. Two classes of seedlings have been raised. In one the susceptible Gros Michel has been crossed with pollen from a wild species of Musa sapientum; in the other two resistant species of Musa cavendishii have been crossed. The work has now reached the second generation stage and the matter of more land for the extension of the work is one that requires immediate attention.

It is not generally realised by people who have been accustomed to dealing with temperate crops which are of necessity annuals, and mature in a few months, the large amount of land that is required for the study of many of the tropical crops and in particular plantation crops. Coconuts and cacao, for instance, are crops capable of great improvement by the application of modern plant breeding methods, yet little has been attempted up to the present. The reason for this is of course two-fold. In the first place the crops are so slow in maturing, that the individual investigator would have to wait a very long time before he even began to see any definite results. Crops of this nature also require a great deal of room the standard spacing for coconuts for instance being 30 feet by 30 feet, and the required space is not usually available for the purpose. For these two reasons, therefore, the plant geneticist has up to the present preferred to work out his problems on annual or quick maturing crops. It is nevertheless a fact that these long period plantation crops are capable of immense improvement by this means and that the world will very soon be faced with the necessity of so improving them in view of the enormous economic importance that these tropical plantation crops are assuming in the economy of the world as a whole.

Long term work of this nature will have to be done by some permanent Institution, such as the Imperial College of Tropical Agriculture, where the records can be properly kept and passed on from one investigator to another over a long period of years without any risk of a break in the continuity. The College authorities are anxious to begin work in this more or less virgin field but in order to do so it is recognised that a suitable estate must be attached to the College for this reason alone.

Research on cotton has been largely left to the Empire Cotton Growing Corporation's Research Station, which has been established within half a mile of the College. The two Institutions work in close co-operation and to each other's mutual advantage. Such cotton as is now being grown on the College is utilised to afford material for instruction or for students' problems. The problem of producing suitable varieties of citrus immune to withertip has continued to receive attention and the question of more intensive work on this class of fruit is referred to in a scheme put forward in the Report on Fruit recently issued by the Imperial Economic Committee.

Work on tobacco has been continued chiefly in relation to the heavy manufacturing types. Genetical studies on Ricinus, Stizolobium and other crops have been continued. The question of green soiling crops has been specially studied particularly in connection with the manuring of cane and its rotation in relation to the general situation on the Froghopper problem.

Cultivating Savannah land ; laying out for plot work and student field problems.
College Department of Agriculture. (*See* page 49.)

Tobacco plots.—*College Department of Agriculture.* (*See* page 48.)

Further trials have been made with jute, and it is now believed that satisfactory yields, more especially perhaps of Corchorus olitorius types, can be raised under Trinidad conditions if the seed is planted at the right time, suitable soil is selected and proper methods of cultivation are employed. It remains to be seen whether the crop can be raised at a profit, under the existing economic conditions that now obtain in the West Indies.

The school of Sugar Technology has now got into its stride with an augmented staff. Investigations have been carried out into the phosphate content of sugar cane juices and an extensive programme of research has now been outlined and will be attempted during the ensuing crop season.

The soil work of the Chemistry division centres round the laterite soils and work has been continued on the physical and chemical properties of colloidal soils. The exigencies of the Froghopper campaign have necessitated what is, in effect, a soil survey of the cane soils of the Island, and this has resulted in the seconding of one of the College staff for this purpose, the work being conducted in the College laboratories.

The record of the last two years shows great expansion, and already the laboratory accommodation is being taxed to its full extent so that a further extension of buildings is now contemplated in order to cope with the extension of work.

THE COMPOSITION OF RAW STARCH.

IT is a well established fact that the material of which starch granules are made is not homogeneous, but is composed of at least two carbohydrate substances, to which the name amyloses is usually applied. Along with amyloses, certain non-carbohydrate substances, notably fatty acids and phosphorus compounds, which may be regarded as impurities, normally occur in starch granules. The physical and chemical properties of the two amyloses are markedly different. For convenience the two varieties may be designated amylose A (sometimes referred to also as amylopectin), and amylose B. Amylose A is more slimy, less soluble in water and denser than amylose B. Because of these and other differences, many attempts have been made to separate the two amyloses from raw starches. Sedementation, centrifuging and selective fermentation have been tried with varying degrees of success.

Recently, Messrs. T. C. Taylor and H. A. Iddles, of Colombia University, New York, have described two new methods for completely disintegrating starch granules. Their work is described in *Industrial and Engineering Chemistry*, July, 1926, p. 713.

Before starch can be separated into amylose A and amylose B, it is first necessary to rupture the granules. This may be done by heating the raw starch with water, or by treating it with warm solutions of an alkali, ammonium thiocynate or chloral hydrate. Ammonium thiocynate gives the best results. The treated starch is gelatinous. Excess of re-agent and water are subsequently removed by precipitation, and by washing with 95 per cent. alcohol. The product is further dried in a vacuum desiccator.

Method for isolating the two amyloses.

Two procedures are described by Taylor and Iddles for isolating the amyloses from the dried material. The first is an ultra-filtration method. Permeable collodion filters are employed to separate the less soluble amylose A from the more soluble amylose B. The second method is electrodialysis. This involves the exposure of aqueous suspension of thiocynate-treated starch to the action of an electric current of 110 volts pressure. Amylose A migrates to the positive electrode, which is placed at the bottom of the dialysing vessel, so that gravity assists the movement of the amylose. When separation into a clear upper liquid, containing amylose B, and a lower flocculent layer, containing amylose A, is complete, the upper layer is siphoned off. It is treated with alcohol in order to precipitate out amylose B, which is thus isolated as a white powder. Repeated addition of water, followed by electrodialysis, effects complete removal of amylose B from amylose A, which is finally left in the dialysing vessel. By freezing and melting, the paste containing amylose A is rendered filterable, so that it can be repeatedly washed and thus further purified. It is finally dehydrated with alcohol.

Properties of the amyloses.

Amylose A, isolated by Taylor and Iddles' methods, is insoluble in water, and, when dry, is a pale-brown hard substance. Amylose B, on the other hand, easily dissolves, up to about 8 per cent. by weight, in water. Iodine gives a deep-blue colour with amylose B solution, but it turns amylose A suspension reddish-violet or purple. Amylose A is only slowly hydrolysed by 10 per cent. hydrochloric acid, whereas amylose B hydrolyses readily, yielding a reducing sugar. Amylose A leaves some ash on igniting, whereas amylose B burns completely away. The main non-carbohydrate component (some 2 per cent.) of amylose A from corn starch, was found by solvent extraction and hydrolysis, to be a fatty acid of iodine number about 91. Phosphorus is also present in some undefined form of combination.

Composition of starches from different sources.

Rice starch contains more amylose A, of higher content of fatty acid, than corn starch. Potato starch contains much less fatty substance (0.02 per cent.) but its phosphorus content is specifically high, phosphorus occurring in both amylose A and amylose B of rice starch.

A more detailed study of the separated amyloses with regard to associated non-carbohydrate substances, may lead to a more precise definition of the components of the granules comprising various natural raw starches, and such study is being continued by the investigators whose work has been described.

F. HARDY.

INSECT CONTROL IN HAWAII.

The following paper by Dr. A. D. Imms, Director of the Institute of Plant Pathology, Rothamsted Experimental Station, Harpenden, England, entitled "The Biological Control of Insect Pests and Injurious Plants in the Hawaiian Islands," has recently appeared in the *Annals of Applied Biology* (Vol. XIII, No. 3, August, 1926).

The sugar planters of the Hawaiian Islands have set an example to the rest of the world in the reliance which they have placed on the application of scientific principles to the cultivation and protection of their crops. Their enterprise has led to the production of a yield of sugar in lb. per acre far in excess of that raised in any other region of the globe. This achievement has had its attendant difficulties for there have been struggles of dramatic intensity between the planters on the one hand and the forces of nature on the other. Among the severest factors they have had to contend with have been the insect enemies of cane. The methods by which the latter have been and are still being subjugated form the subject of the present essay. It was the desire to obtain an insight into the fundamental principles governing this work that prompted the present writer to visit the Islands in 1925. A great measure of profit and pleasure derived from this experience is due to the generous hospitality and assistance afforded by Mr. F. Muir, Mr. J. W. Waldron, of the Sugar Planters' Experiment Station Committee, arranged exceptional facilities for visiting the Islands of Hawaii and Maui, and Mr. O. H. Swezey rendered valuable aid in obtaining material illustrating some of the chief features of the Hawaiian insect fauna.

The Hawaiian Islands are now so well known that any detailed description is out of place here. It may be mentioned, however, that they lie 2,100 miles south-west of San Francisco and at about the same distance north of Samoa. They are very isolated and are surrounded by ocean attaining a depth of 16,000 feet. Of the eight inhabited Islands the largest is Hawaii which has an area about twice that of the county of Norfolk. All the Islands are of volcanic origin and included in the archipelago are the highest mountains in the Pacific, Mauna Kea attaining an elevation of 13,823 feet. Of the many volcanic craters two are active, viz.: Mauna Loa and Kilauea the latter being the largest active crater in the world. The climate of the Islands is cool and healthy, considering the latitude, with a mean annual day temperature of 80°F. and 68°F. at night. The rainfall varies enormously in different localities: in one region only about 12 ins. fall in the course of a year while in other parts it may exceed 300 ins. The staple industries of the Islands are the growing and export of sugar and pine-apples. The flora is extremely rich and is remarkable for the very high percentage of endemic genera and species. A further noteworthy feature is the extraordinary development of usually herbaceous genera into trees or shrubs. There are no indigenous land mammals while the insect fauna, like the flora, includes a high proportion of endemic forms. It is, however, perhaps even more notable on account of the absence of whole orders and major groups which are represented in most parts of the globe. Thus, there are endemic Trichoptera, Plecoptera, Ephemeroptera or Mecoptera: there are no Chrysomelidae, Scarabaeidae or Tenthredinoidea: there are only two truly endemic species of butterfly, a single endemic species of ant and no endemic mosquitoes.

The changes that have taken place in the fauna of the Islands, through the demolition of native forests and the general spread of cultivation, have inevitably led to the extermination of many endemic species of insects. At the same time, the maritime importance of Honolulu, as "the cross roads" of the Pacific has facilitated the entry, through commerce, of many alien species. A number of these immigrants are now firmly established and among them are major pests whose presence has threatened the whole prosperity of the Islands. In view of this process of substraction and addition that is still going on to-day, the wisdom and foresight of those Englishmen who inaugurated the *Fauna Hawiiensis*, and saw it through to completion, can scarcely be over-emphasised. This work is the scientific basis for all subsequent progress in Hawaiian entomology besides being an important contribution to our knowledge of island life in general. The part enacted by Dr. R. C. L. Perkins in bringing so much of the material together in his own personal contributions to the *Fauna* volumes are enduring monuments to his credit. The *Fauna Hawaiiensis* describes and records what species are endemic to the Islands and what species are introduced, thus providing the economic worker with indispensable information. Except for the existence of this work, he would be continually at a loss to know whether he was dealing with a native or an introduced species and would be encompassed by difficulties regarding what course of action to take.

General Remarks on Biological Control.

Biological control of injurious insects has achieved a degree of success in the Hawaiian Islands not attained elsewhere. On the other hand, artificial methods of repression have generally proved expensive and given but poor results in that same region. Hawaiian pests are almost entirely immigrant species which have become established in the Islands, unaccompanied by the naturally occurring enemies which normally prey upon them in the lands from whence such pests originally came. The climate of the Islands is remarkably uniform, the temperature rarely falling below 60°F. or exceeding 92°F. Under such conditions hibernation is almost a non-existent phenomenon. An environment so favourable conduces to the rapid multiplication of insect pests, but it is none the less advantageous for the introduction and spread of beneficial

forms. The latter can be colonised at almost any time of the year and are able to pass through uninterrupted cycles of development, owing to the abundance of their hosts and the absence of a dormant season. Furthermore, the unique character and the simplicity of the indigenous fauna, with its paucity of hyperparasites and other likely competing forms, provides a biological association offering but few obstacles in the struggle for existence.

It should not be assumed, however, that success in biological control, even in so favourable an environment as the Hawaiian Islands, has come easily, or that every beneficial insect introduced has become established in its new surroundings. The history of insect control in these Islands, if fully written up, would have to include a number of failures and recount the expenditure of strenuous efforts and of large sums of money. Thus, the complete control of the sugar-cane leafhopper only resulted after the introduction of about a score of different enemy species and after about twenty years of work. The search for effective wireworm enemies has now been maintained for several years but so far without the desired success. On the other hand, the control of the *Anomala* beetle and recent attempts to control the Avocado mealy bug have achieved success in a remarkably short interval of time.

The earliest experiment in the introduction of a beneficial insect into the Hawaiian Islands was apparently in 1890. In that year A. Koebele forwarded a consignment of the ladybird *Novius cardinalis* from California to Honolulu for the purpose of attempting the control of the cottony cushion scale *Icerya purchasi*. The latter insect was, at that time, as destructive to citrus fruits in the Islands as it was in California. The experiment resulted in its complete subjugation and ultimate decline into insignificance. During subsequent years more than 90 different species of beneficial insects have been successfully introduced from various countries into the Hawaiian Islands and a complete list of these has recently been published by O. H. Swezey (1925). A far greater number of species, however, have failed to become established: a complete list of these is not available but a considerable proportion are on record (*vide* Swezey). In judging the success or failure of these experiments it should be pointed out that the objective is to bring about a reduction in the numbers of the pest concerned. If, for example, introductions are attempted with ten different species of parasites and only two species succeed in establishing themselves and these two are effective in restraining the host, the experiment is to be regarded as successful. It is wide of the mark to say that there were eight "failures": the object was to secure a desired degree of control rather than to ensure the establishment of all the parasites handled. A large proportion of the parasites that "failed" as Mr. Muir has pointed out to the writer, could have been established if the experiments had been continued. When success has been attained in reducing a pest, such as the *Anomala* beetle, for example, by the aid of a single species of parasite or predator, further efforts to establish other species may be deemed unnecessary. Beneficial insects that have established themselves the most readily are generally those best adapted to the environment and such species usually prove the most satisfactory from the economic standpoint. With some species successful establishment has only been secured after a long period, but generally such insects are not very effective under Hawaiian conditions.

The first entomologist to be employed on work of biological control was A. Koebele who was appointed in 1892 and served under the Territorial Government. Prior to 1904 the Sugar Planters' Experiment Station was but a small concern occupied with the study of soils and fertilisers. In that year the Station was enlarged and its scope widened. The first entomologists to be appointed on the staff were Messrs. Perkins, Kirkaldy, Terry and Swezey; about that time Koebele was seconded in a consulting capacity and Muir joined the organisation in 1905. The Experiment Station began the great part which it has played in the introduction of beneficial insects from 1904. The Territorial Board of Agriculture and Forestry has participated in this work, as have also the United States Experiment Station and the Honolulu Laboratory of the U.S. Bureau of Entomology.

The Sugar-Cane Leafhopper.

One of the most interesting and striking examples of the biological control of an injurious insect in the Hawaiian Islands is afforded by the sugar-cane leafhopper, *Perkinsiella saccharicida*. It appears to have entered the Islands about the year 1897 and had increased to an enormous extent by 1902. Sugar production, for example, in a single infested plantation fell from 19,000 to 7,000 tons in three years and the conversion of some of the plantations into cattle ranches was mooted. A discussion naturally arose with regard to what measures were to be adopted in combating the menace of the leafhopper and it soon became evident that, owing to local conditions and the nature of the sugar-cane crop, no artificial methods were likely to meet the situation. The previous success occasioned by the control of *Icerya purchasi* and other pests, by the introduction of their natural enemies, had much influence in the adoption of biological measures. It was in 1903 that A. Koebele, acting on suggestions made by Dr. L. O. Howard, made extensive observations on Dryinid and other leafhopper parasites which had been previously studied by O. H. Swezey in Ohio. This resulted in Koebele sending over a good deal of living material to the Hawaiian Islands, but technical knowledge of such parasites was at that time very scanty and the experiment resulted in much wasted effort. Most of these parasites were subsequently proved to be very restricted in their range of hosts with little likelihood of attacking the sugar-cane leafhopper.

In 1904 Perkins and Koebele visited Australia with the object of studying the leafhopper in its original environment and with special reference to securing any effective parasites that were available. Perkins returned to Honolulu early in 1905, while Koebele remained in Queensland to continue the field observations. He returned from Australia later having, in the interval, also visited Fiji. The outcome of their efforts was the introduction of several parasites and predators, but certain of these failed to become established. The most promising were Chalcid parasites attacking the eggs of the leafhopper. Thus, *Paranagrus optabilis*, Perks. was introduced by Perkins and Koebele from Queensland, while Koebele secured *Ootetrastichus beatus* Perks.[1] from Fiji. About eighteen months after these introductions had been accomplished, the damage entailed by leafhoppers fell to about half its original proportions and during the following year, some 75 per cent. of the infested areas were under the influence of the beneficial insects. Outbreaks still occurred in certain districts and a condition of more complete control was aimed at. F. Muir embarked on work of a similar nature, and during 1906-7, secured the Dryinids *Haplogonatopus vitiensis* from Fiji and *Pseudogonatopus hospes* from China. It should be mentioned that other Dryinids had been previously introduced into the Islands by Perkins and Koebele, but they failed to become established. The hopes that were at one time entertained of the value of this group of parasites never matured. *Pseudogonatopus hospes* for example, was not recovered until nine years after its first introduction, while other of the species have entirely disappeared. The failure of these enemies to fulfil expectations appears to be due partly to local conditions, but more especially to hyperparasites. Some of the latter were probably native species which, owing to their minute size, had previously remained undetected, while others gained an entry into the Islands as chance immigrants brought in through commerce. It now became evident that, in order to effect the desired degree of control, some robuster type of leafhopper enemy was needed which would also withstand the bad conditions occasioned by heavy rains. An apparently promising species was secured by Muir in Fiji and Queensland. This insect was a small Capsid bug, *Cyrtorphinus mundulus* (Bred.) which lives by sucking the eggs of the leafhopper. The selection of this insect was an entirely new venture in biological control since none of the predaceous Hemiptera had been previously employed. Since the members of the family to which it belongs are almost exclusively plantfeeders this zoophagous habit was indeed exceptional. Muir's observations, however, showed that the habit was apparently a fixed one, nevertheless the lurking possibility of the insect varying its behaviour under new surroundings had to be watched for. The introduction of the *Cyrtorhinus* was effected in 1920, and, at first, it seemed doubtful whether it was going to maintain itself. Its subsequent sudden increase and spread allayed these fears and it is now generally conceded that the *Cyrtorhinus* is the one species which has completed the subjugation of the leafhopper to-day. The effects of the activities of this bug are truly remarkable and during the writer's visit to the Islands it proved difficult to find many examples of the cane pest which was once so abundant and so destructive.

It is evident that, with the introductions of the new components thus recounted, the biological association that has become centred around the leafhopper has greatly increased in complexity. It is always possible that unforeseen factors may in the future upset the balance thus established and bring about conditions favourable to the multiplication of the leafhopper, thus occasioning local outbreaks of that pest. It is occurrences of this nature that need constant watching for. A prevalence of strong winds in one direction might easily result in the accumulation of small numbers of surviving leafhoppers in sheltered cane fields. If followed by torrential rains such delicate egg-parasites as *Paranagrus* would probably suffer severely and a local reinfestation by the leafhopper result. A heavy tax might then be placed upon the capacity of the *Cyrtorhinus* to cope with the situation, and a condition demanding fresh efforts arise.

1 *Ootetrastichus formosanus* Timb., introduced by Muir from Formosa, in 1916, has also contributed to the decline of the leafhopper.

(*To be continued.*)

COTTON-JASSID IN SOUTH AFRICA.

J. L. MOERDYK, Dip. Agric., B.Sc. (Agric.)

WITH the rapid increase in the production of cotton in South Africa the cotton growers, more especially those in the lower parts of the country, generally called the "Low-veld," find themselves threatened with the advent of a serious pest. This pest, the cotton jassid, promised at one time to put an effectual stop to the production of cotton over large tracts of country. It seems probable, however, that after a short period of adjustment the menace can be overcome or side-stepped by a change in agricultural methods, or the growing of resistant strains. Competent men are working on this problem and will doubtless solve it in a comparatively short time.

There is very little doubt in the minds of most cotton-growers that the jassid is responsible for the damage done. The symptoms are roughly as follows: The leaves first turn yellow, then red and finally drop off; no more flowers are produced and the crop is considerably reduced. Very little, however, has been done to prove that the cotton jassid is the responsible agent and is not merely an insect or bug which shows up concurrently with the disease. The writer was in the fortunate position of being able to make a few preliminary investigations on the question of jassid and the jassid resistance or susceptibility of certain strains of cotton in South Africa.

The objects of these investigations may briefly be summarized as follows :—

i. To find the causal agent in the spread of the disease.

ii. To see how the deterioration of the plant is brought about.

iii. To find the cause of the resistance of some strains to the disease and the susceptibility of others.

iv. To study the habits of the jassid.

The cotton crop is planted in October or November depending on the first rains. Planting is done on the flat in rows 3 feet apart and the plants are usually 15 to 18 inches apart in the row. Implemental inter-cultivation and hand-hoeing are carried out. The rainfall may be anything from 20 inches to 40 inches or over and falls within a period of 5-6 months mostly in the form of heavy showers. The range of soils is very great but almost invariably responds to phosphate treatment. There appears to be a fair supply of potash.

No jassid effect is noticeable in the early season. About midsummer (early January) the most susceptible plants will show a few leaves turning yellow around the edges and curling up slightly. The younger leaves never show the disease but the older ones change from yellow to red from the edges inwards. This condition becomes worse until the most susceptible plants are entirely red and in many cases lose their leaves. Very often the weaker plants seem to go under first. In an ordinary cotton field a red patch may suddenly appear in any part of the field. This patch rapidly extends in area in all directions so that after a few weeks the whole field appears red. The malady is usually at its worst in early autumn, February, March and April. After this the jassids become less numerous, probably due to cooler night temperatures, and the plants partially recover, although usually too late to ripen any more bolls that may be formed.

From casual observations it seemed as if plants badly affected had more jassids on them than healthier plants, and, in order to verify this, counts of the number of jassids, in all stages of development were made on several strains of cotton. The following is a summary of counts made on 5 separate strains and varieties on different dates. These counts were made on 2 plants in each strain, 5 leaves, as nearly as possible in the same position and of the same age, shape and size being used on each plant.

Variety.	*Susceptibility.*	22 Feb., 1926.	19 Feb., 1926.	1 Mar., 1926.	11 Mar., 1926.	27 Mar., 1926.	Total.
Watts Long Staple	V.S. ..	33	55	47	75	68	278
Bancroft ..	V.S. ..	34	47	81	81	72	315
Bancroft ..	Resistant	1	1	3	10	28	43
Z. i 9 ..	V. Resistant	3	2	2	12	8	27
Cambodia ..	Immune ..	0	0	0	0	0	0

The above table shows a direct relation between susceptibility and the number of jassids present.

In order to study the effect of jassid on the plant several controlled experiments were carried out. Seven pairs of plants were enclosed in cages of fine metal screening (1,600 meshes to the square inch). Plants making up the pairs were as nearly as possible identical as regards growth and diseased conditions. All plants belonged to the uniformly very susceptible variety Watts' Long Staple. These plants were all fumigated twice, with Calcium Cyanide, with an interval of one week between fumigations, and on examination showed no living insects of any description. After the first fumigation, all except badly damaged leaves recovered within a few days and very rapid growth started immediately. After the second fumigation about 200 jassids were introduced into one cage in each pair, the other receiving no jassids. In all cases the effect of the jassids introduced was visible within a few hours, decided wilting setting in. Within 2 days the typical discoloration of the leaves showed up and growth stopped. Within 3 weeks there was a marked difference in the heights of the different plants.

Original height of both plants 18 inches.

Height at time of second fumigation—20 inches in both plants.

Height at end of experiment—Jassid plant 20 inches.
Jassid free plant 35 inches.

The above are the measurements of one pair.

In all instances the same results were obtained the control plants growing vigorously while the jassid infested plants stopped growth and showed typical "jassid effect."

Several manurial experiments were carried out to study the effect of different fertilizers on the resistance of the plants to the malady. The treatments consisted of dressings of superphosphate, potassium and nitrogen and complete fertilizers. There were also a number of control plots. Each treatment was carried out on four different plots. In no case was any effect visible, all the plots eventually succumbing to the disease.

The negative results of these experiments cannot be taken as indicating that some plant food deficiency may not be a general predisposing cause, and the whole question of environmental effect should be studied thoroughly.

From the controlled cage experiments together with the jassid counts in the field, it is evident that whatever other factors may have an effect, the cotton jassid certainly is the causal agent in the deterioration of the plant.

(*To be continued.*)

A gratuitous specimen copy of *Tropical Agriculture* will be sent, post free, to any member of an agricultural society or to any other individual interested in tropical development on application to the Editor, *Tropical Agriculture*, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

TOBACCO CULTIVATION.

PROFESSOR J. SYDNEY DASH, B.S.A.

[*Substance of an address delivered to the Trinidad Agricultural Society 20th January 1927, and embodying the results of certain field studies, on tobacco cultivation begun in 1923 by Professor Dash. The area under cultivation at the present time is approximately 1½ acres and includes work on both the varietal and commercial aspects of the crop.*]

IT is not intended nor is it possible in a single effort to cover the subject of tobacco growing in all its various aspects and ramifications. It is a highly specialized industry, and one in which there is ample room for trained experts, for the crop is a peculiar one and not rivalled by any in regard to effect of soil, climate, fertilizers, handling, &c., on the final product. So much so indeed, that even those best qualified in its culture are at times baffled by its behaviour and varying response to the conditions under which it is grown. This is not hard to understand when it is remembered that the tobacco plant enjoys a very wide distribution, being cultivated on every continent of the globe—Europe, Asia, America, Africa, Australasia, all figure in the production of various types and classes. It thus happens that what is termed quality in tobacco, as in many other products while difficult to define, depends very largely on a point of view; the quality required in cigarette tobacco, for example being very different from the quality required say in a heavy pipe or plug tobacco. The grower, however, must keep certain generalised distinctions in mind since soil and treatment are most important factors, apart from variety considerations, in determining quality; and in the long run, the grower is limited to the type he can profitably cultivate by the nature of his soil and environment. No other crop is so influenced by these factors as is tobacco, judged from the point of view of manufacturers' requirements, and high agricultural yields are, within limits, sacrificed in order to satisfy these requirements. Quality in the case of bright tobacco particularly, is usually enhanced where the crop is grown continuously on the same land.

It may be of interest to note that tobacco in the United States, the world's largest producing country, was at an early date subject to certain economic laws. Thus, in 1621, the profits were so great and the production of food crops neglected to such an extent that each colonist was limited in regard to the number of plants he could grow and even in the number of leaves allowed per plant. The expansion of the American industry since those early Virginian days has been phenomenal, for the crop is now grown in 42 States on nearly half a million farms and possesses a value of many millions of dollars.

British territories having relatively important tobacco industries are: India, Canada, Union of South Africa, Rhodesia, Nyasaland, Ceylon, and Australia. Considerable interest has developed in Nyasaland because of its suitability to the production of bright leaf probably closest in quality to that produced in the United States, which has hitherto enjoyed almost a complete monopoly in this particular class. Small but successful industries exist in other places, Jamaica furnishing a good example. Under the existing protection it might be possible to supply some of the local demand, notably in the heavier manufacturing types. The Colony is importing annually about 500,000 lb. of unmanufactured leaf. With the decrease in cigar smoking generally and the special exigencies of the trade in this class of tobacco, new prospects for it are not promising.

The following is a brief outline of the more important points in the culture of the crop:—

Classes and Varieties.

There are two main classes of tobacco: the cigar and the manufacturing. The differences are commercial and varietal rather than botanical, both coming under the same species—*Nicotiana tabacum*. *N. rustica* constitutes another class grown mainly for nicotine production and includes also Turkish and Levant tobaccos. The cigar group at the College is represented by the following varieties: Comstock Spanish, Big Havana and Connecticut Havana (all used as filler and binder) also four strains of Sumatra wrapper leaf. The manufacturing class may be divided into three groups of varieties: bright, heavy and special types. The first is represented in our collection by Hickory Pryor, Warne and Gold Leaf; the second by Kentucky One Sucker, Yellow Mammoth and Tennessee Red; the third by White Burley and Maryland. There are also in the plots two strains of *N. rustica* under observation for nicotine production. The first group demand special curing facilities in the way of flue-barns if a high quality bright leaf is to be obtained, and for special studies in this work it is hoped to be suitably equipped before long. Hickory Pryor is a promising variety in this connection. In the meantime, all varieties are being air-cured in the usual way.

Both Kentucky One Sucker and Yellow Mammoth are good yielders of heavy tobacco under our conditions. The greater part of the commercial area at the College is devoted to these two and an effort is being made to get accurate figures as to cost of production on this area.

Soils and Climate.

As noted previously, environment plays an important part in determining the type of tobacco to be grown. Broadly speaking, sandy or clay loams of high fertility are best suited to cigar tobacco, since the plants must make rapid and continuous growth, especially where high quality wrapper leaf is aimed at. In the case of bright tobacco, typical soils are light, infertile, sandy loams, liberal applications of fertilizers being used to produce the crop. For dark, heavy-bodied tobacco the soils may be more clayey in texture than for the other classes and richer

in organic nitrogen ; alluvial soils and the heavier loams are very suitable—in fact almost any good fertile soil gives satisfactory results. No matter what the type of soil, unless it is well drained, profitable crops of tobacco cannot be produced.

The rainfall should be moderate but well distributed throughout the growing period and rather light during the maturing and harvesting period ; heavy rains, especially at harvest time, are very prejudicial to the quality of the leaf which is rendered thin, deficient in gums and light in weight in proportion to bulk. Planting is therefore done in time to catch the late rains, allowing for sunny dry weather as maturity approaches.

Seed and Seed Beds.

The tobacco plant being propagated from seed, the grower should take every precaution to select vigorous plants, true to type, and uniform in respect to time of maturity, as seed bearers. Where more than one variety is grown the seed heads should be bagged (any strong paper bag serves the purpose) before the flowers begin to open. The bags are retained in position until the seed capsules are full, it being necessary periodically to raise the bag as the flower stalk elongates, at the same time removing the old fallen flowers from the bags and destroying any bud-worms that may be at work. As soon as the seed pods turn brown they should be harvested and allowed to further dry out in a cool, dry room, free from vermin. The seed is then shelled, winnowed and placed in glass containers (*e.g.*, jam bottles), taking care to reject that from poorly developed capsules which will be light and will tend to produce poor plants. Tobacco growers in many places are often inclined to favour the use of imported seed as against home grown, believing that the latter soon deteriorates. There is, it is true, every danger of this when seed selection is not practised.

The seed bed is the next care and the operations connected therewith must be regarded as an essential feature in tobacco cultivation. Failure at this point means crop failure. In the first place, a well-sheltered, well-drained spot with access to water supply must be chosen ; the soil should be fertile and plentifully supplied with humus. The preliminary preparation consists in clearing and levelling followed by thorough working of the soil, with the incorporation of a liberal supply of well decayed compost or manure. The site is then lined off into beds of convenient size about 3 to 4 ft. wide with paths between which serve also as drains. Some method of sterilizing the beds to destroy weed seeds, ants, disease spores, &c. is next recommended ; for this purpose brushwood and other material should be piled on top of the beds and set on fire. The beds are afterwards brought to a fine tilth by careful mixing in of the ash resulting from the burnt brush, care being taken not to bring up unsterilized soil from below. The surface of the beds should be level in every respect ; they are then ready for sowing and should be seeded at the rate of one teaspoonful of tobacco seed to 10 square yards ; for even distribution the seed should be thoroughly mixed with some substance such as wood ashes before sowing. The surface of the beds after sowing is lightly pressed with a smoothing board before watering, which should be done from a can with a fine rose. Sometimes a quick acting fertilizer is applied to the beds. The area of seed bed necessary can be judged from the fact that in 1 ounce of tobacco seed there are approximately 100,000 and an average teaspoon holds about 25,000 seeds when level. All the beds should not be sown at once ; three or four sowings at intervals of about 14 days are suggested, depending on the area to be planted and to provide sufficient material for supplying losses from insects or other causes. It is a common practice to provide some sort of covering for the nursery beds ; under the humid conditions of this climate, where too much shading is given the beds are subject to damping-off troubles, and except for suitable shelter from wind and heavy rains covering the beds is not absolutely necessary. The seeds germinate in from 7 to 10 days and the seedlings are ready for transplanting in from 6 to 8 weeks when they are 4 to 6 inches high ; undersized plants may be used only if weather conditions are favourable as they are liable to be killed out by hot sun. On the other hand, large plants may run to seed before normal growth has been attained. Beds to provide seedlings for transplanting during November and December, when the bulk of our planting is done, are sown from mid-September to the end of October. It is recommended that the site for seed beds be changed annually to avoid insect and fungus troubles. Where thorough sterilization can be effected the change need not be so frequent.—(*To be continued.*)

COLLEGE LAND.

ON another page will be found an illustration giving a general view of a field being brought under cultivation for research and student field studies. With an additional three acres recently broken, practically all land available for agricultural work on the present College estate has now been taken in, altogether about 25 acres—an area which it is recognized is now totally inadequate for present requirements.

One of the difficulties in connection with the present area is the unevenness of its fertility and some time must elapse before it can be regarded as being in the best condition for investigational work. It is imperative, therefore, that no time be lost in acquiring new land for future development in order that these initial difficulties may be suitably overcome without hampering progress.

In the case of the savannah land in the illustration, it had first to be stumped and ploughed and then sown down to a cover crop for months before it could be utilized.

TROPICAL WORLD NOTES.

New Guinea.

The Director has spent a considerable amount of time on tours of inspection during the year 1923-1924, and much information has been collected. Upon this information has been based a report on the appointment of an entomologist and a report on the organisation of the Agricultural Department. Valuable scientific work carried on under the late German Administration, has been published in German periodicals; this has yet to be collected and brought to the notice of those engaged in the plantation industries.

The question of transport has necessarily confined the selection of planting sites to the sea coast. A fairly extensive geological survey of the Island has shown that many of these sites are quite unsuitable for the type of crops grown. Coconuts have been planted in stagnant swamps and can never be expected to be of any value.

Inspection of village agriculture has been made, and although important centres of population have yet to be visited, and the inspection records are, as yet, somewhat incomplete, sufficient observation has been made to indicate that native agriculture is in a very backward state. Past efforts of the administration have been directed chiefly towards increasing the area of the village coconut gardens, perhaps without adequate explanation of its importance in the interest of the native. Other factors which contribute towards lack of progress in native husbandry are native suspicion of the white man from lack of knowledge of his motives, and the natural distaste for work of a community who have not inherited a natural inclination towards agriculture owing to the fact that there has never been any economic necessity for work, since most of their food can still be obtained from the forests and by the rudimentary cultivation of taro, yams and bananas.

* * *

Bermuda.

A recently published Colonial Report shows that during last year a heavy decrease took place in the total trade of Bermuda, the value at £1,491,061 comparing with £2,261,275 in 1924. As usual imports accounted for the bulk of the total trade. They declined, however, by nearly £500,000. Exports were valued at only £166,020, which was nearly £300,000 less than shipments during the previous year.

Of the imports the United States was the largest source of supply with a total contribution valued at £674,240, as compared with £384,044 by the United Kingdom, and £244,460 by Canada. The largest items of import from the United Kingdom were :—Fancy goods, £72,304 ; clothing, £30,600 ; cotton goods, £27,990 ; woollen goods, £27,717 ; whisky, £27,306 ; malt liquor, £26,756 ; cigarettes, £13,667 ; and wine, £10,407. The principal exports from the Colony consists of vegetable produce and lily bulbs.—(*Chamber of Commerce Journal.*)

British Guiana.

According to a recently published Colonial Report (No. 1,300, H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2., price 1*s*. net.) the total value of imports into British Guiana during 1925 (not including transit trade) amounted to £2,908,434, as compared with £2,744,145 in the previous year. Under the classification of" articles wholly or mainly manufactured," receipts were valued at £1,602,903, while imports of food, drink and tobacco reached £1,057,216.

Exports during the same year were valued at £3,130,706, which represents a decrease as compared with 1924 of £262,823 or 7.74 per cent. and includes re-exports valued at £163,611. Shipments of sugar in 1925 amounted to 97,728 tons, worth £1,413,696, as against 85,896 tons, valued at £1,767,125, in 1924. Rum was exported to the extent of 1,148,124 proof gallons, and 769,304 proof gallons in 1924, the respective values being £117,127 and £75,803.

Other exports were as follows :—Rice, 6,918 tons; coconuts, which decreased from 1,559,000 in 1924 to 1,363,280 ; copra, 17,278 cwt. ; coconut oil, 30,294 gallons ; coffee, 5,964 cwt., as compared with 4,581 cwt., in 1924 ; concentrated lime-juice, 8,430 gallons, and essential oil of limes, 306 gallons. The output of alluvial diamonds during the year was 182,895 carats, valued at £819,816, a slight decrease as compared with 1924. There are in existence in the Colony three ironwork foundries, two well-equipped factories for the manufacture of boots and shoes, two biscuit factories, and many aerated water factories are in operation. Matches are also manufactured, and a certain quantity of leather and cocoa is prepared for local consumption.

The United Kingdom was the principal trading country with British Guiana, accounting for 47.72 per cent. of the total trade, followed by Canada with 24.32 per cent., and the United States with 10.57 per cent.—*Chamber of Commerce Journal.*

* * *

St. Lucia.

The output of sugar during the past season was greater than that of last year, but the low market price seriously affected the value of the crop. Exports of sugar, molasses and syrup during 1925 were valued at £85,151 as against £109,818 in the previous year. The cocoa crop was somewhat impaired by wet weather, but although exports in 1925 showed a decrease of 1,720 cwt., the value was higher than in the previous year. Lime cultivation received more attention, and the crop came in gradually, which enabled the planters to harvest better and to gather and put to use more of their crop than in the previous season. Coconut plantations are giving good results, and the cultivation is being extended. The value of imports in 1925 totalled £277,013, while that of exports was £243,207.—(*The Board of Trade Journal*, Vol. CXVII, p. 553.)

Swaziland.

According to the latest report on Swaziland (No. 1,307 H. M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 6*d*. net) trade in the Colony during 1925 was, on the whole poor. The beginning of the year gave great promise of a successful agricultural season, but heavy rains in March and the consequent increase in pests, had a severe adverse effect upon crops in general and on maize and cotton crops in particular.

The imports consist principally of flour, sugar, groceries, hardware, clothing, boots, spirits, oils, farming implements, mining machinery, tools and general kaffir truck. The main items of export during last year were as follows: Cassiterite tin £67,722; unginned cotton, £7,013; ginned cotton, £2,984; hides, £1,038; slaughter oxen, £36,759; tobacco, £6,981.

Experiments with regard to cotton cultivation are being carried out under the supervision of the Empire Cotton Growing Corporation, and it is anticipated that valuable information will be forthcoming. Tobacco growing is increasing and is no doubt one of the most valuable crops suitable for Swaziland. The country is especially suited for cattle raising, and it is estimated that the number of cattle in Swaziland to-day approximates 300,000. There were exported during the year 7,436 head. Cassiterite produced during the year amounted to 277.5 tons (metallic content 70 per cent.) valued at £67,722, all of which was exported, and gold reached 1,308.54 oz., valued at £5,558, as compared with 241.03 tons of Cassiterite and 376.13 oz. of gold during 1924. It is stated that large deposits of coal exist in the bushveld, but beyond prospecting operations, nothing has as yet been done to exploit them.—(*The Chamber of Commerce Journal*, Vol. LII, p. 544.)

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Bahamas.

The import trade of Nassau for the last quarter of 1925 showed an increase of £147,000 as compared with the corresponding period of the previous year, but there was a decrease of £10,084 in the value of the exports owing to poor crops of fruit in consequence of prolonged drought during the summer months. Other industries, notably sponge, lumber and Bahamas hemp, showed satisfactory progress. The general increase in the imports of cotton goods, provisions and motor cars in 1925 accounted largely for the improvement in the import trade.

There has been a marked increase in the value of real estate during the last twelve months, but otherwise conditions generally have remained very much as formerly. Land development has resulted in a shortage of labour, which, however, is not likely to continue.—(*The Board of Trade Journal*, Vol. CXVII, p. 553.)

Montserrat.

Total imports into Montserrat, Leeward Islands, during 1925 were valued at £59,803, while exports amounted to £43,876. Most of the imports were distributed among countries of the Empire, receipts from the United Kingdom amounting to £14,638 (25 per cent.), Canada £18,549 (31 per cent.), and the British West Indies, £16,921 (28 per cent.). The share of the United States was 15 per cent. The United Kingdom was by far the principal purchaser, taking 90 per cent. of the total exports.

Unlike most of the British West Indies, Montserrat is a sugar importer, the local production of this commodity being very small. Principal imports during the year were flour, rice, lumber, salt fish, meat products, sugar, soap, cotton cloths, hardware and machinery. The flour and salt fish come almost entirely from Canada, while Great Britain supplied most of the cotton cloths, soap and machinery.

The principal export item was cotton, shipments of which reached 342,863 lb., valued at £38,913, or 88 per cent. Other products were cottonseed oil and meal, and a very small quantity of sugar. Most of the cotton and cotton products went to the United Kingdom. Montserrat has benefited from an upward tendency in the prices of Sea Island cotton, and an increase in the acreage under cotton cultivation is reported.—(*Chamber of Commerce Journal*, Vol. LIII, p. 545.)

* * *

Northern Rhodesia.

A scheme has now been instituted in Northern Rhodesia under which funds for advances to selected growers are provided in equal proportions by the Government and the Empire Cotton Growing Corporation. Borrowers have to limit their cotton plantations to a maximum area of 50 acres, the advances being fixed at £3 for every acre under cotton, a further advance not exceeding £1 per acre being permissible in special circumstances. As the sanction of the Colonial Office had to be obtained for this scheme, it affords a clear indication of the faith of the Imperial Government in the future of cotton growing in Northern Rhodesia, a belief evidently also shared by the experts of the Empire Cotton Growing Corporation. — (*Manchester Guardian Commercial*, Vol. XIII, p. 669.)

* * *

Nigeria.

According to the *Monthly Review of Barclays Bank*, the Agricultural Department of Nigeria continues to work on the improvement of the local native varieties of cotton in the middle belt and this work is progressing favourably. The rainfall and climatic conditions generally are such that the varieties of American cotton which flourish in the north cannot be expected to do so in the middle belt, and it is upon the improvement of the native cotton that development in this region must depend.—(*Times Trade and Engineering Supplement*, 24th December, 1926.)

THE PRINCIPAL'S REPORT

For the Academic Year 1925-1926.

(*Concluded.*)

Publications.

1. *Tropical Agriculture.*—This monthly journal, the organ of the College, has appeared regularly throughout the year. A reduction to twenty-four pages has been made, but this reduction is due to pressure on staff and editorial organisation, and not to lack of suitable material. Efforts are being made to establish correspondents in the different Colonies and Dependencies who will supply articles recording developments of general interest within their respective colonies and a complete record of colonial agricultural development is thus aimed at. Mr. C. J. Lewin, Senior Botanist, Agricultural Department, Nigeria, has kindly consented to represent Nigeria, Mr. G.H. Mundy, Chief Agriculturist, South Rhodesia, and Mr. H. Wolfe, Deputy Director of Agriculture, Tanganyika, and our thanks are due to these officers.

From the business aspect the Journal has prospered, the number of subscribers has increased considerably, and the Journal now circulates throughout more than a hundred colonies and countries. Publishing houses have responded well in forwarding books for review, and there is a welcome addition in the number of advertisers. The two latter facts indicate that the Journal is rapidly becoming a recognised medium for business propaganda.

2. No further progress has been made in the establishment of a medium for the publication of scientific papers, and such publication of "Memoirs" is dependent on financial provision. Pending this development such papers are published in the Standard Journals.

3. The following papers have appeared during the year :—

1. Cohesion in Colloidal Soils. F. Hardy. *Jour. Agric. Sci.* Oct., 1925, XV, 4, pp. 420-433.
2. Percolation in Colloidal Soils considered in relation to Swelling and Cohesiveness. F. Hardy. *Jour. Agric. Sci.* Oct., 1925, XV, 4, pp. 434-443.
3. Anomalous Flocculation in Colloidal Clays and Soils. F .Hardy. *Jour. Phys. Chem.*, Feb., 1926, XXX, pp. 254-264.
4. Lime Juice Colouring Matter. F. Hardy and F. H. S. Warneford. *Indus. Engin. Chem.*, Jan., 1925, XVII, 1, pp. 48-50.
5. Manufacture of Calcium Citrate and Citric Acid from Lime Juice. F. Hardy and F. H. S. Warneford. *Indus. Engin. Chem.*, Dec., 1925, XVII, 12, pp. 1283-1289.
6. The Imperial College of Tropical Agriculture. H. M. Leake. *Jour. Roy. Soc. Arts*, Jan., 1926, LXXIV, pp. 164-172.
7. Insect Pests and Cotton Development. H. A. Ballou. *Empire Cotton Growing Review*, Oct. 1925, II, 4, pp. 323-329.
8. Studies on the Ætiology of Sugar-Cane Froghopper Blight in Trinidad.
   I. Introduction and General Survey. C. L. Withycombe. *Ann. Appl. Biol.* 1926, XIII, No. 1, pp. 64-108, 4 figs.
9. Additional Observations upon *Boreas Hymenalis*. C. L. Withycombe, *Entom. Mo. Mag.*, 1926. LXII, pp. 81-83, 3 figs.

In addition to the above, the staff have contributed freely to the pages of *Tropical Agriculture.*

Library.

1. The Library was transferred to the new building in September, and is now under proper control for the issue and receipt of books. Unfortunately, the room is already inadequate in size, and the full library cannot be accommodated in it. Cataloguing is proceeding. The grants required for expansion, especially in the matter of back numbers of current journals, are still wanting, but notable additions in the form of gifts here noted have been received during the year, and are gratefully acknowledged. ;

1. *The Journal of the Chemical Society*, 82 vols., by Sir Francis Watts, K.C.M.G.
2. *Journal of the Royal Society of Arts*, 31 vols. presented by the Society.
3. *Journal of the Linnean Society*, 25 vols. and parts, presented by Sir David Prain, F.R.S.
4. *Proceedings of the Royal Society*, 23 vols., presented by Sir David Prain, F.R.S.
5. *Annals of Applied Biology*, 6 vols., presented by Sir David Prain, F.R.S.
6. *Science Progress*, 61 vols. presented by Sir John Farmer, F.R.S.
7. *The International Catalogue of Scientific Literature*, Botany, 13 vols. presented by Dr. H. M. Leake.
8. *Botanisches Centralblatt.* 33 vols. Presented by Dr. H. M. Leake.
9. *Biologia Centrali — Americana-Botany.* 5 vols. Presented by Dame Alice Godman.
10. *Contribution to Indian Botany*, by Sir David Prain. 2 copies. Presented by Sir David Prain, F.R.S.
11. *Neues Handworterbuch der Chemie*, 6 vols. Presented by Mrs. V. M. Urich through Mr. F. W. Urich, Entomolcgist to the Department of Agriculture, Trinidad.
12. *Jahres-Bericht uber die Untersuchungen und Fortschritte auf dem Gesammtgebiete der Zuckerfabrikation*, 12 vols. Presented by Mrs. V. M. Urich through Mr. F. W. Urich.

The Sugar Factory.

During the year the Factory did not operate. In some respects this was unfortunate, but it has afforded the much needed time to work out a well considered scheme for the Technology department and to select a suitable staff. Through the courtesy of the proprietors of the Usine Ste. Madeleine, the two students taking the course have spent the crop season in the Factory working under Mr. W. Scott, Technologist to the Usine. The College is further indebted to the authorities of the Usine Ste. Madeleine for agreeing to an arrangement by which the services of Mr. Scott have been rendered available to take charge of the course in Technology. The scheme for the future course will be based on co-operation between the Departments of Chemistry and Technology, while the entire scheme involves co-operative research on the same basis.

Administration.

1. *The New Building.*—The year is characterised by the completion and occupation of the new building. The Entomological department and the library were transferred during September before the session commenced, subsequent departments to move in at Christmas were Botany, Agriculture, Economics and Administration. With the transfer of the Mycological department in April, the building became fully occupied. Pressure on space, however, still remains great, and with an expanding staff and an increasing number of students further accommodation is even now required. The space released in the old block has been divided between the Chemistry department, the Sugar Technology department, and the department of Hygiene and Sanitation, while one room has been allocated and fitted out as a laboratory for the Froghopper work to be undertaken by Mr. Turner.

His Excellency Sir Horace Byatt, K.C.M.G., Governor of Trinidad and Tobago, opened the new building on 13th February. The members of the Parliamentary Delegation then visiting Trinidad, namely, Viscount Peel, Lord Queenborough, the Right Hon. F. O. Roberts, M.P., Mr. A. E. Jacobs, M.P., and Captain Evans, M.P., were present on this occasion.

2. During the year a Mansfield's Gas plant has been installed, and is now working very efficiently. Oil gas is being supplied to all laboratories and is infinitely more efficient than the Petrol gas hitherto available.

3. Progress has been rendered possible in the direction of a hostel by the gift of the British Government of a sum of £15,000. An area of four acres with a private house on it has been purchased for approximately £3,100. The house will form the basis of the residential quarters and the area is sufficient to allow of considerable expansion. The dining hall and common room will form a separate building situate on the present estate. It is unfortunate that construction will take too long to enable the hostel to be used for the session 1926-27. The property faces the College, which now controls the frontage on the public road bounding the estate on the East.

4. Approximately twelve acres of the estate have been brought under cultivation, and a further eight acres bought last year from the Government is now being added to this. The total cultivated area remains too small for the requirements of research and teaching and, in view of the rapid expansion in numbers of students, further facilities are urgently required.

5. A small property of one acre with dwelling which formed a projecting area on the northerly boundary of the estate has been purchased, and the estate boundary is now the Government railway on both the North and West.

6. The promise of additional funds has permitted a much desired expansion of staff by which all departments with the exception of that of Mycology will be staffed by a minimum of a Professor and a Lecturer. The anxiety necessarily due to the absence of a reserve for illness and leave is now limited to the one department. The new staff will join by the beginning of the Academic year 1926-27.

7. That the College offers advantages which are not limited to its educational function or for research by members of the staff is becoming more apparent with time. As early as 1923-24 Mr. Farnell, Research Chemist to the Empire Sugar Research Association, spent a year at the College, and now facilities are being arranged for Mr. Turner, working under the auspices of the Froghopper Committee. Dr. J. S. Dunkerly, formerly lecturer in Parasitology, Glasgow University, and Professor Elect of Zoology, Manchester University, has initiated a fashion, which it is hoped will become common, by spending three months vacation working in the College. The rich fauna and flora of the Island as well as its varied agriculture offer a wonderful field for officers holding such posts. It is hardly necessary to emphasize that such visitors will be welcome and all available facilities, both for work and accommodation, will be placed at their disposal.

8. There is one point which I should, in conclusion, like to place on record. It is the debt the College owes to the Government of Trinidad and especially the officers of the Department of Agriculture for the generous manner in which they have lent their aid on all occasions. The neighbouring Departmental experimental Station has been freely placed at disposal for teaching purposes, and in the absence of sufficient cultivated area at the disposal of the College itself, full advantage has been taken of the facilities for teaching purposes. Our thanks in this matter are due to Mr. W. G. Freeman, Director of Agriculture. To Mr. Nowell, Assistant Director of Agriculture, who, to our regret, is leaving the Colony, we owe much. Especially latterly, as the Chairman of the Froghopper

Committee, he has associated himself wholeheartedly with officers of the College. The organisation of that Committee, in fact, forms an outstanding illustration of co-operative action. Especially also must I mention Mr. F. W. Urich, who has freely offered his invaluable knowledge of the local fauna to students studying Entomology. Lastly I must mention the planting community who have, in a most liberal manner, entertained students on their estates and thus demonstrated the practical business side of agriculture in a manner with which an Educational Institution can hardly compete. It is, perhaps, invidious to refer to individual instances, but I must make especial mention of Mr. G. C. Skinner of the Usine Ste. Madeleine and his staff for their generous help, and especially for the facilities provided in connection with the two students who spent the crop season at that factory.

H. M. Leake.

October, 1926.

Students who have passed through the Imperial College of Tropical Agriculture are now employed in the following parts of the British Empire: The Union of South Africa, Southern Rhodesia, Uganda, Nigeria, the Gold Coast, the Sudan, Ceylon, Barbados, Trinidad, Antigua and British Guiana.

SUGAR-CANE EXPERIMENTS

At Usine Ste. Madeleine, Trinidad.

The report on the sugar-cane experiments for the season 1925-26, conducted on the above estates, has been issued. It has been prepared by Mr. G. A. Jones, the Agronomist in charge of field experiments, and is divided into four parts which deal with :—

(I) Experiments with varieties of sugar-cane.
(II) Manurial experiments with sugar-cane.
(III) Liming experiments with sugar-cane.
(IV) Other experiments with sugar-cane.

During the wet season the rainfall was ample, well distributed, but not excessive, and the canes made excellent growth up to the end of January. From February to the end of the crop in May, the rainfall on the various estates varied between 1.42 inches and 4.23 inches as against 7.34 inches and 10.88 inches for the similar period in the previous year, and consequently towards the end of the crop season the canes suffered severely. The total rainfall for the year, on the five estates on which the experiments were carried out varied between 50.44 inches and 68.67 inches.

Another factor which influenced the results obtained was the outbreak of froghopper blight during the months of August to October, 1925, on two of the stations where experimental work was being done. At the same time it has been decided to maintain a series of plots in districts where froghopper is prevalent in order to form a basis for the further investigations of this pest. The plots were laid out over a wide range of soils, classified into five groups and known as, black soils, brown soils, red soils, the older alluvial soils and the newer alluvial soils.

Twenty-one different varieties of cane were tried out in variety trials on different soils. In all cases where the variety B.H.10 (12) was included it took the lead, and on a black soil where one plant crop and two ratoons were taken, it gave a yield of 96.8 tons of cane, yielding 17.00 tons of sucrose over the three crops 1924-26. Uba came next with 113.1 tons of cane yielding 13.35 tons of sucrose over the three crops. Some of the plots have served to demonstrate the serious nature of the froghopper pest. Plant canes yielded between 36 to 40 tons per acre and were estimated to give 25 to 30 tons per acre as 1st ratoons, but as a result of the blight these yields were reduced to a mean of 13 tons per acre in the case of the more resistant varieties, and 5 tons per acre in the case of the more susceptible ones. Uba is the most resistant and is followed by the B.H. 10 (12) and S.C. 12/4 varieties. The variety Ba. 11569 appears to be particularly susceptible to attack, but is otherwise a very promising variety and is recommended for districts where froghopper blight is not prevalent. The usefulness of Uba as a cane for the poorer types of soil has again been clearly demonstrated. Coimbatore seedlings have been introduced with the object of establishing a cane equal in vigour to that of Uba, but of better thrashing facility. The juice from Co. 214 is superior to that of Uba and of Co. 213, but the field returns of Co. 214 are inferior to those of Co. 213. Until the ratooning power of these canes is known, it is too early to discuss them.

The next part of the report deals with manurial experiments.

In the first series of experiments the object was to determine :

(*a*) Whether 40 or 60 lb. nitrogen was the most profitable application.

(*b*) The best form in which to apply nitrogen, whether as (1) Sulphate of Ammonia (2) Nitrate of Soda (3) or mixture of Nitrate of Soda and Sulphate of Ammonia or (4) Nitrate of Lime.

(*c*) Effect of annual applications of small dressings of pen panure.

Unfortunately an attack of froghopper rendered most of the results unreliable, in the experiments with first ratoons. At the same time the results obtained tend to show that a dressing of 40 lb. of nitrogen, one-half as Nitrate of Soda and the other half as Sulphate of Ammonia is the most satisfactory application of nitrogen and also that too heavy dressings of pen manure are wasteful under tropical conditions. In fact the significant increase in crop due to the addition of artificials to a basic dressing of pen manure was so small, as to indicate that the return from artificial fertilizers would be unremunerative on the soils and under the conditions prevailing on the Ste. Madeleine Estates.

Part III of the report deals with liming experiments.

Soil analyses showed the red soils and old alluvial soils to be deficient in lime, and consequently the experiments were conducted on these soils. Here again, the significance of the results obtained was affected by the froghopper pest, and there is nothing to indicate that any advantage has been derived from liming. Crops from these areas will be reaped separately over a number of years and it is hoped, that by so doing, some definite results will be obtained.

Among other things in part IV of the report it is pointed out that a field that is to remain in cultivation for a number of years, deserves the most careful selection of the planting material. With this idea in mind, stools that were markedly above the average in number of stalks per stool, size of cane in stool, freedom from disease and borer, and in general vigour, were selected for planting material. Increased tonnage due to selection was noteworthy, being 1.9 tons in the case of Ba. 6032 and 3 tons with B. 156.

It is unfortunate that the froghopper attack so much influenced the results of the experimental work in the season 1925-26, but it is thought that the work has been planned in such a way that the accumulation of knowledge will become of increasing value as the investigation proceeds over a number of years. While it is realised that the results obtained are primarily for the use of the management of the Ste. Madeleine Estates itself, it is thought that if the report were presented in such a manner that it could be understood and appreciated by planters and others, who do not possess any knowledge of statistical presentation, it would be a useful and valuable addition to the practical literature of the industry, and would be especially valuable to planters whose soils and conditions are similar to those at Ste. Madeleine.

A. L. B.

THE AVOCADO PEAR.

SOME years ago the avocado pear was described as one of the greatest undeveloped sources of food which the tropics offer at the present day. From the *Canada-West India Magazine* one learns that the co-operative organization of the California growers has given notice that an educational campaign in favour of the avocado pear is soon to be launched, and it is expected that in 1927 hundreds of car loads will be shipped East.

The pear, a native of Tropical America, was introduced into Florida in 1833, into California in 1871 and is now found in Algeria, South Spain, France, Italy, Réunion, Madagascar, Polynesia, N. Australia, Mauritius, the Canaries, Madeira and the Philippines.

The Californian growers propose to make a place for the avocado in the ordinary American diet and as a stable foodstuffs, rather than a salad fruit or luxury. Their task, however, will not be easy. It will take a long time before the public becomes habituated to the pear. There are many varieties, and few appeal immediately to the palate of peoples of non-tropical zones.

In picking and preparing for the market, care and judgment must be used. It must not be picked unripe or the flavour will be unattractive to the new comer; on the other hand it must not be over-ripe or it will not keep.

Although the tree takes some time to come to maturity, from the point of view of yield—it is stated that an acre planted to avocado pears will yield a larger amount than any other tree crop—it should recommend itself to the grower.

The different varieties—the main ones being Mexican, Guatemalan and West Indian—mature in different periods, but the maximum time is about five years. According to G. B. Cellou, the West Indian variety at 7-10 years old should yield 5-10 crates reckoning 40 fruits to the crate.

California lists some 400 varieties in several family groups. The Mexican race, thin skinned, highly flavoured and very rich, was first introduced but the Guatemalan is tending to replace it. This ranges in size from three quarters of a pound to three pounds or more; the skin is tough and thick, and the colour varies from green to deep purple. The Florida alligator pear is of the West Indian race.

The fruit has a definite food value and the *Canada-West India Magazine* says analysis shows that the avocado is a substitute for milk and eggs, whilst the United States Department of Agriculture and the University of California, in the last ten years have taken pains to show that it ranks higher in vegetable oil content than the average olive, that the protein and mineral content is more than twice that of other fresh fruits, and the energy value is more than that of lean meat.

G. W.

EGYPTIAN SUGAR.

THE sugar industry of Egypt, which, after cotton raising, has for years held second place, is on the decline, as shown by the report of the Société Generale des Sucreries et de la Raffinerie d'Egypte. This company, which formerly had a practical monopoly of sugar for Egypt and the Sudan, is now face to face with serious competition from Central Europe. The cane ground by this company decreased from 1,138,984 tons in the 1923-24 season to 845,176 tons during the 1924-25 season. Sugar sales have dropped from $26,408,000 in 1920 to $11,627,000 in 1925.

The great decline in the domestic industry is further shown in the decreasing exports, which in 1925 amounted to only 12,046,000 pounds valued at $715,190, as compared with almost 32,000,000 pounds valued at $2,307,000 during 1924. Imports, on the other hand, increased from slightly less than 89,000,000 pounds valued at $4,765,000 in 1924, to almost 166,000,000 pounds valued at nearly $7,000,000 in 1925. The increase in sugar imports is accounted for by the unprecedented demand for beet sugar for local consumption. Czecho-slovak sugar represents almost 65,000,000 pounds of the 1925 imports.—(*Sugar*, November, 1926.)

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Sugar as a Fertilizer.

Large quantities of sugar have been recently used as a fertilizer in Florida. The matter was referred to Dr. Oswald Schreiner, Senior Biochemist in charge of the soil fertility investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, who makes the following comment :

" Sugar contains nothing of direct fertilizing value, but experiments have shown that, when used on soil, nitrification is stimulated by the supply of readily decomposed carbohydrates, which supply energy to the soil bacteria, and thus aid in the decomposition of other nitrogenous materials in the soil with production of nitrates. The nitrification as a rule takes place at the expense of the stored up nitrogenous materials in the soil, and it does not always follow that this increased nitrification is an advantage unless the crop is right there and ready to take it up. We have been experimenting somewhat with the heavy molasses residues, and have obtained some favourable results with this material, but the question here is quite a different one, as these residues really contain some fertilizing materials, such as Nitrogen, phosphate and potash, in addition to the sugar."

* * *

Selection of Seed Cane.

Owing to the destructive spread of Mosaic disease, The Louisiana Sugar Experiment Station in 1920, selected and planted two rows of cane stalks showing a minimum of mosaic infection and two rows of unselected seed cane alongside. The difference in favour of the selected seed was very noticeable ; and in 1924 many planters started selected seed plots. Increases in yield up to 14 tons per acre, or 32 to 34 per cent. have been obtained. — *African Sugar and Cotton Planter*, November, 1926.

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Causes of Corrosion in Pipe Lines Carrying Condensates.

L. M. Glazener, Arch. Suikerind, 34.435-50 (1926).

Experiments are cited to show that in sulphitation factories the acidity of the clarified juice bears no direct relation to the degree of juice sulphitation, but is dependent rather on the quantity of $CaSO_3$ that can exist in the juice under given conditions. It is thus affected by a number of conditions. Nor is there any relation between the acidity of the clarified juice and that of the vapours given off, or their condensates. Air leaks have a pronounced affect on the corrosive effect of condensates, through oxidation of SO_2 to SO_3, and of aldehydes to organic acids. If the material of which the pipe lines are made is not homogenous there is strong local corrosion, which endangers the life of the pipe.— *Abs. The Planter and Sugar Manufacturer*, 1st January, 1927.

A successful Cane Harvester.

Work is connection with the Falkiner Cane Harvester in Australia is progressing very favourably. So far the ground cutting and topping has been all that can be desired, and the cane experimented with to date has been cut in the leaf. All trash is removed, and the only difficulty experienced is that some of the removed trash is included with the cane. This difficulty may be obviated by additional air blast.

A mechanical grab has been found to work satisfactorily for loading, and further practice of the loading gang may conpletely solve the loading problem.—*South African Sugar Journal*, 30th November, 1926.

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Australian Wages.

The award governing the conditions of sugar-cane cutting in New South Wales made by the Sugar Field Workers (State) Board, was recently determined. The duration of the award is three years and rates and wages are effective as from September, 1926.

It is set out that, where crops are below five tons per acre, or have been seriously damaged by flood, wind, grubs, &c., the rate for cutting shall be mutually agreed upon between the employer and the employee. In the event of the parties being unable to agree, the cane inspector of the mill by which the cane is to be crushed shall determine the rate of pay, which " will enable a diligent and competent cutter to earn not less than one pound sterling per day."—*Sugar*, January, 1927.

CANE CREAM.

METHODS for making cane cream, a secondary product of domestic cane sugar factories, have been developed in the past year by the Carbohydrate Laboratory, Bureau of Chemistry, United States Department of Agriculture.

The cream is made from juices of cane extracted from the last mills. These juices have a smaller percentage of sugar than the juices from the first mills, and consequently increase the average cost of sugar production when they are converted into sugar.

Uses for cane cream suggested by the experiments of the Carbohydrate Laboratory vary according to the consistency of the cream. Thin consistency might be used as syrup on hot cakes and breads, or on ice cream. Heavier consistencies are appropriate for use as a sandwich spread and for cake icing. Candy fillings, similar to fondant fillings, may be made from the cream, it is also suggested. — (*Empire Production and Export* No. 124, p. 308.)

The Editor will be pleased to send a gratuitous specimen copy of *Tropical Agriculture*, post free, to anyone interested in tropical development.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The High Price of Lime Oils.

The high figures which the buying prices of ecuelled oil of limes and of distilled oil of limes have reached during recent months, have been the source of much amazement. The following approximate figures show the rapid upward rise in these prices. The figures have been taken from various sources, mainly the *Essential Oil Record* for December, 1926.

Year.	*Ecuelled oil.*		*Distilled oil.*	
	s.	d.	s.	d.
1912 January ..	5	0	1	4
1923 January ..	6	3	1	8
1926 January ..	22	6	10	0
May	40	0	30	0
July	35	0	30	0
October ..	45	0	36	0
November ..	44	0	35	0

These prices hold for sales in London. Prices in the United States show similar upward trend; they have reached even higher figures. Recently, prices have dropped considerably.

Various reasons have been suggested to explain the rapid upward trend. It has been assumed, for instance, that the demand for lime oils has increased very much of late. Indeed, *The West India Committee Circular* for 2nd December, 1926, p. 476, states in a note on the subject, that increasing quantities of lime oils are being used in the United States for the manufacture of sweet drinks, such as ginger ale. Reliable information recently obtained direct from New York, however, refutes the supposition that an increased demand for lime oils has arisen. It states, on the contrary, that the real reason for the present high price is reduced production in the West Indies, owing chiefly to the ravages of Withertip disease of lime trees, which have caused many lime estates in Dominica to become unproductive. The demand for lime oils has *not* risen, nor has their popularity increased.

Concentrated lime juice, on the other hand, has recently fallen in price in the United States, because demand in England has definitely decreased. Citric acid crystals were formerly manufactured from concentrated juice in English factories, but nowadays, citric acid is being produced in large quantities in Italy and exported to England, where no duty is charged on it. There is thus only a small market for concentrated lime juice in England, so that the United States market is well supplied, and prices there have consequently fallen. There is a heavy duty imposed on citric acid imported into the United States; it pays there to imported concentrated juice. In 1923, concentrated lime juice was fetching £24 per hogshead in New York. Nowadays, the selling price is only £17 per hogshead.

Producer gas as motor car fuel.

In continuation of two former notes on this topic (*this Journal*, p. 218 (October) and p. 237 (November) 1926), we are able to present some details of a successful producer gas plant for motor lorries and tractors. This plant is made in Britain by The Parker Producer Gas Company, of 62 Conduit Street, London, W.1., and can be fitted to almost any type of petrol motor tractor used for road haulage or land tillage. Full details are given in a brochure issued by the Parker Company, and prices can be obtained by reference to the Company or its agents. The essential parts of the apparatus are a *hopper*, or fuel container, fixed on top of a *generator*, the two comprising a cylinder. A *water-tank*, for furnishing steam, is conveniently attached to the hopper. A *preheater* heats incoming air, and also vapourizes the water issuing from the water tank through a drip-feed cock. A fan feeds the fire with air, and a *cleanser* containing baffle-plates, together with a *filter*, prevent dust from passing into the engine cylinder. An *air mixer control valve*, operated by a lever and bowden wire, and a second *air regulator* to the generator, enable the driver to control the gas supply. The inlets do not interfere with the engine carburettor, so that petrol or paraffin may be used immediately when required. For making a suitable charcoal, the Parker Company also manufactures portable retorts that require little labour for their manipulation.

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Electro-deposition of Rubber.

A new method of manufacturing rubber articles, such as gloves, water bottles, bathing caps and tobacco pouches, in which india-rubber is deposited by an electric current passed through latex containing compounding ingredients, has recently been developed. The process is based on the results of an investigation undertaken by Dr. S. E. Sheppard of the Eastman Kodak Company (*see Industrial and Engineering Chemistry*, 1925, p. 711). A large company has been formed for the commercial exploitation of Dr. Sheppards' discovery. It is to be named the American Anode Company, and involves the Goodrich Company, the Eastman Kodak Company and the British Anode Rubber Company. The works will be set up at Akron, Ohio, U.S.A. Revolutionary changes in the rubber industry are predicted as a result of this development.—(*News Edition, I. E. C.* 10th Nov., 1926).

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Power Alcohol in Queensland.

At Cairus, Queensland, a power alcohol plant, producing about one million gallons of spirit per annum, is to be erected next year by The Australian National Power Alcohol Company. This new Company will start with a capital of one million pounds. It will erect another similar plant the year after next, at Townsville. The raw materials to be employed are molasses and starchy products, such as cassava and sweet potato, which are to be grown as rotation crops between cane crops.

REVIEWS.

THE ESSENTIAL OILS, by Horace Finnemore, London, Ernest Benn, Ltd. 1926, £3 10*s.* 0*d.*

This is the most recent book in the English language describing the composition, methods of recognition and sources of the essential oils that find chief use in the perfumery trade. The book comprises 865 beautifully printed pages. The contents are arranged under plant families, in 76 chapters. In the Preface it is stated that much of our present knowledge of the essential oils has been acquired in German and French laboratories, where industrial needs have furnished the main urge to research. This stands in sharp contrast to British practice, where no such co-operation occurs. Thus sandal wood and ajowan fruits are both widely cultivated in a British Dominion, yet their essential oil components were, before the war, for the most part distilled outside its boundaries. Whilst the British Empire possesses all the necessary climatic and other growth conditions, essential oil plants are not afforded by British growers and manufacturers the attention they deserve. Nevertheless, it is pleasing to record that signs of awakening interest are forthcoming, for example, in India, and that investigators in Australia are still furthering their studies, commenced some thirty years ago, of the essential oils of certain plant families, notably the Eucalypts and the Pines.

The essential oils may be classified according to the nature and the relative amounts of the various characteristic chemical substances they contain (terpenes, alcohols, aldehydes, ketones, phenols, esters, &c.), and this mode of classification may be of greater value to the manufacturer than the biological mode of classification adopted in this book. Nevertheless, attempts to prepare by chemical synthesis, substitutes for certain natural essential oils are not always successful (even apart from questions of cost), mainly because the natural product generally contains traces of certain highly odorous substances, often of unknown identity, which confer on it a characteristic "bouquet" or "body" not possessed by the artificial product. Sharp limits are thus frequently circumscribed to the possibilities of synthetic manufacture, and these become even more firmly fixed when questions of cost are also introduced. The would-be essential oil plant grower need not therefore be deterred by fear of rivalry by the synthetic chemist, provided he makes himself conversant with the needs of the trade, and with the limitations of practical chemistry. A valuable asset of the book under review is that the author is fully aware of the importance of a correct understanding of the possibilities of chemical synthesis, and nowhere attempts to belittle it, or to mislead the grower into a false feeling of security. Hence, in describing the known natural essential oils in turn, he adopts the following sequence of topics:—Botanical source, its limitations; Cultivations; Climatic and other factors controlling successful production; Commercial production; Annual output; Chemical composition; Historical development and present position; Physical characters; Analytical chemical examination; Uses in industry. The data presented are taken from wide sources, and ample references to original articles are given in numerous footnotes. The book furnishes a most valuable addition to the English literature of Essential Oils, and, despite its high price, it should be studied by all tropical planters who contemplate growing essential oil plants for profit.

F. HARDY.

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INSECTS; THEIR STRUCTURE AND LIFE.—By Geo. H. Carpenter, D.Sc., J. M. Dent & Sons, Ltd., London and Toronto, 1924, price 10*s.* 6*d.*

This is a revised and up-to-date second edition of Prof. Carpenter's book, bearing the same title published nearly thirty years ago, which had been out of print for several years. All who have used the book in its first edition will welcome it in its revised form. A primer of entomology, it is called by its author, and it covers the ground for an elementary study of entomology in a remarkably efficient and comprehensive manner. The text deals with the subjects necessary for a good understanding of insects and the student will find it most useful and interesting as a text book. The excellent text figures are much the same as in the first edition and in addition, there are four coloured plates which are of much interest.

The preparation of this second edition has given opportunity for the inclusion of the more important results of recent investigations. The increase in the number of the bibliographical references, the inclusion of many recent ones and the deletion of some of those of earlier date, bring this section of the book thoroughly up-to-date.

Convenient in size, attractively printed and neatly bound, Prof. Carpenter's *Insects* is a book which can be unreservedly recommended to students of entomology and others who wish to understand the essentials of insect structure and life.

H. A. B.

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DICTIONARY OF BOTANICAL EQUIVALENTS. By Ernst Artschwager, Ph.D. and Edwina M. Smiley, M.A. (2nd edition). The Williams and Wilkins Co. Baltimore, 1925.

The thanks of all botanists have been due since 1920 to Dr. Artschwager and Miss Smiley for their excellent little dictionary, and the indebtedness is increased by the appearance of the second edition. Not only has rearrangement of the type resulted in a more convenient volume, but both German and French sections have been amplified, and best of all two entirely new sections have been added, giving the English equivalents of Dutch and Italian botanical terms. In its present form the dictionary is a book that will be a constant aid in the reading of foreign literature.

E. E. C.

COLLEGE NEWS.

Captain Metivier, lecturer in Veterinary Science, accompanied by Mrs. Metivier and son, returned from England on the 19th January, by the s.s. *Pellerin de Latouche.*

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The Trinidad Agricultural Society met at the College on 20th January. After the general business was completed, Professor Dash gave a lecture on tobacco cultivation which was followed by a field demonstration.

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Mr. R. B. Cunninghame Graham, during his stay in Trinidad, came to the College on 3rd February. Mr. Cunninghame Graham has represented various Scottish constituencies in Parliament and is a well known writer.

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Visits were paid to the College on 26th January, by Mr. S. Morse of Colombia, S.C. Editor of *Facts About Sugar*, and on 29th January, by Mr. Joseph R. Fisher, a distinguished English journalist and late Editor of the *Northern Whig*, Belfast.

* * *

Among the visitors to the College during February were: The Hon. Carl and Mrs. de Verteuil, accompanied by Mrs. M. de L. Woods of New York City, Mrs. A. W. Darton and Mrs. N. Kerlin of Washington, D.C., and Miss G. E. Morgan of Hants, England.

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Lieut.-Col. Ivan Davson, *en route* for Berbice, British Guiana, for the purpose of inspecting the sugar properties there, visited the College on 3rd January, and discussed the possibility of the institution of a course of training for estate managers and sub-managers.

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Captain Watson, Manager of Waterloo estate, came to the College on 12th January, and delivered a lecture on Cost Accountancy with regard to sugar estates. Collections of the various records kept on his estate were handed round amongst the students and were much appreciated.

* * *

On 19th January, Lord and Lady Newton visited the College. In 1916, Lord Newton was Under-Secretary of State for Foreign Affairs. They were accompanied by Miss Elizabeth Hanbury Williams and Lieut.-Gen. Sir Aylmer L. Haldane, Commander-in-Chief in Mesopotamia in 1920-21.

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A visit was paid to River estate on 17th January, by a party of senior students, accompanied by Professors Dash and Cheesman and Mr. Baker. Mr. O'Connor, the manager, conducted the party to the curing sheds, where the sweat boxes, drying floors and fermenting beans were examined. Later, in the fields, the students saw results of trials of different varieties of cacao, the influence of shade and of tree spacing. The processes of cropping and preparation were also seen. A short time was spent in the citrus grove. Thanks are due to the Trinidad Agricultural Department for their courtesy and for so kindly placing the facilities at River estate at the disposal of the party.

* * *

The Trinidad Science Club, the constitution of which was altered at the beginning of the present Academic Year in order to admit post-graduate students to membership, has had a series of successful meetings. On 28th October, Dr. Martin Leake spoke on "The Agricultural Conditions of the Sudan." At the next meeting, Mr. Dodd, the writer of the article which appeared in last month's journal, gave an address on "Cotton in America." On 9th December Mr. Moerdyk gave us an account of research on the Jassid in Barberton, Transvaal, and papers are now being published in the journal giving the substance of this work. Captain R. C. Marshall, on 27th January, gave an address on "Forestry," and on 24th February, Mr. Olivier, a senior student with considerable experience, told us about "Tobacco in Africa." It is due largely to the energy of Mr. Olivier that the objects of the Society have been brought before the senior students, and his work was recognised by a hearty vote of thanks passed by the Society at its meeting on 27th January. On the 31st of the present month, Mr. F. W. Urich, Entomologist of the Department of Agriculture, will speak on "Snakes in Trinidad."

Officers for the Session 1926-27 are:—

Mr. G. Evans	*President.*
Mr. W. G. Freeman Dr. T. G. Mason	*Vice-Presidents.*
Mr. G. Wright	*Hon. Secretary.*
Professor H. A. Ballou Professor F. Hardy Capt. R. C. Marshall Mr. V. F. Olivier Mr. F. W. Urich	*Committee.*

Meetings take place monthly in the Chemistry Lecture Theatre of the Old College Building.

ADVERTISEMENTS.

MR. HENRY H. R. MOLE, of Little Neck, Long Island, New York, has been appointed advertising agent for *Tropical Agriculture* in the United States of America and Canada. All communications from those countries respecting advertisements should be addressed to him. The address of our advertising agent in the United Kingdom is 14, Trinity Square, London, E.C.3. Firms in the West Indies and British Guiana are requested to address their communications to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Throughout December and the first week of January, sugar prices were stable and an event of the New Year was the quick rise of about 1*s.* 3*d.* in all specifications. The firm tone, however, later became less apparent. What is wanted is a recurrence of trade demand, and this can hardly be delayed for long, as the comparatively new policy of buying from hand to mouth is apparently still in existence. In the United Kingdom, about the middle of January it was difficult to find any interest in anything except parcel lots, a few of which (raws) were sold at around 16*s.* 3*d.* to 16*s.* *c.i.f.* It is encouraging to note that in spite of the large increase in unemployment last year, the consumption of the United Kingdom was more than maintained. Latest cabled London quotations (2nd February) are 15*s.* 3*d.* *c.i.f.* for foreign, 96°; and 19*s.* for preferential. The New York market for 1927 opened well but later became uneventful, the apathy shown by Refiners being due in no small measure to the fact that they are at present holding fair stocks of Refined and are experiencing, as is usual at this time of the season, a very slow demand for their products. This caution has been still further encouraged by the rapidity with which the harvesting has been taken up in Cuba, where, according to latest advices, 155 mills are grinding, as compared with 142 at the same date last year. The 3rd February quotation for *c.i.f.* per 100 lb. of Cuban 96° was $3.14.

COTTON.—The January price graph for cotton looks more cheerful. The reduced spinners takings last season were partly due to the coal strike but perhaps more to the fact that mills and consumers alike were imbued with the idea that a further decline would be seen in cotton. Long continued price steadiness and the development of a bullish tendency is causing Lancashire to revise its ideas. Manchester reports have been encouraging and some business has also been done with China. The United States reports a distinct improvement in the textile trade and although France and Italy, with their altered exchange situation are not so promising as they were last year, Germany and Czechoslovakia show improvement. According to latest advice, Sea Island has been neglected, American has been in good demand, large business has been done in Peruvian, good business in African and moderate in Brazilian. The Egyptian market has been quiet.

CACAO.—Since mid-November there has been a continuous rise in Accras from 55*s.* to over 65*s.* and after 15th December, this was shared by other descriptions, Trinidad L.L.T. which stood at 70*s.* in mid-December, is at time of going to press (3rd February) 82*s.* to 84*s.* All cocoa is at present firm trade. There is very little in bond, and the situation seems likely to remain in holders' favour for several weeks ahead if not until after Easter.

COFFEE.—Coffee prices show no material change. Kenya and Costa Rica new crop are the sorts for which there has been most call. New crop Costa Ricas were offered pretty freely. These for the most part have shown an improvement in colour and general appearance over the earlier arrivals, and, under the influence of an increased demand from the Continent, the market has presented a very firm tone. Owing to the adverse weather conditions in Costa Rica, the present crop is expected to be later than usual, and further reports suggest that the crop is only likely to be two-thirds of that for last year. Home trade interests were confined to the African kinds, the majority of the qualities offered being from Kenya. A strong demand prevailing for the fine grades and recent prices were well maintained. Central American, other than Costa Rica, is scarce and easily makes full prices.

TEA.—Although the market for better qualities remains good, low grades have been offered freely and as a result tea averages show a decided decline.

Indian.—A strong market exists for all teas with good leaf or liquor, but common to low medium sorts in good quantities caused a slight decline.

Ceylon.—A steady demand has prevailed and the prices recorded for high grown sorts were fully firm to dearer. Averages as recorded for the first week of 1927 are Ceylon 19.01*d.*, Indian 15.60*d.*, Java 10.60*d.*, Sumatra 11.50*d.*, Assam 16.74*d.*, and Darjeeling 16.52*d.* per lb.

RUBBER.—With the New Year forward contracts not purely speculative began in earnest. There are numerous sound industries which need assurance of monthly deliveries of rubber for many months ahead. On 12th January, business was done at the following rates—Ribbed smoked sheet, Spot sellers 1*s.* 7¾*d.*, January, 1*s.* 7¾*d.*; February, 1*s.* 8*d.*; March, 1*s.* 8¼*d.*; April to June, 1*s.* 8½*d.*; July to September, 1*s.* 9*d.* Eastern Plantation Rubber gained increased firmness and America and the Continent sent orders. Off grades were again slow of sale. Permitted exports for 1926 were 95½ per cent. of the whole so that control was not very severe. The average price for the last restricted quarter was 19.19*d.* For the quarter beginning 1st February, there was a cut to 70 per cent. Buyers are beginning to realise that a cut to 60 per cent. will come into operation automatically in May unless the average price reaches 1*s.* 9*d.* If this cut is to be avoided the price during the quarter will at times be above 1*s.* 9*d.*